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EXAMINER	
WOODS, ERIC V	

ART UNIT	PAPER NUMBER
2672	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/644,829	SATOH, KIYOHIDE	
	Examiner	Art Unit	
	Eric V. Woods	2672	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 25 May 2005.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1,3,5,7-12,17,19,24 and 26-28 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1,3,5,7-12,17,19,24 and 26-28 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 21 August 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

by

DETAILED ACTION

Response to Arguments

Applicant's arguments, see Remarks pages 1-3, filed 25 May 2005, with respect to the rejection(s) of claim(s) 1, 3, 5, 7-12, 17, 19, 20, and 24 under 35 U.S.C. 102(b) and 35 U.S.C. 103(a) have been fully considered and are persuasive in view of applicant's amendments, since applicant has canceled several claims and incorporated their limitations into the independent claim, and otherwise changed the claims sufficiently to require new rejections (specifically moving from 35 U.S.C. 102(b) on the independent claims to 35 U.S.C. 103(a). Therefore, the rejection has been withdrawn.

The rejections of claims 2, 4, 6, 13-16, 18, and 21-23 under 35 U.S.C. 102(b) and 35 U.S.C. 103(a) are withdrawn since the claims have been canceled.

However, upon further consideration, a new ground(s) of rejection is made in view of various references as below.

Examiner does not regard the changing of the word 'orientation' to 'orientation' in the claims as changing claim scope. Firstly, applicant does not specify that such a change in wording was made in order to differentiate and/or alter claim scope. Secondly, the Chen reference as below specifically teaches an **orientation** sensor on the video camera anyway (3:65-4:10). Lastly, two definitions of orientation from dictionary.com are:

1. The orientation of an aircraft's axes relative to a reference line or plane, such as the horizon.

2. The orientation of a spacecraft relative to its direction of motion.

The definitions of the term therefore indicate that the word is synonymous with and equivalent to the term "orientation" in any case.

The other changes, such as the word 'creating' to 'generating' require further search and consideration, and as such justify the shifting of the rejections from 35 U.S.C. 102(b) to 35 U.S.C. 103(a).

Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. Specifically, applicant incorporated the limitations of claim 2 into claim 1. While examiner concedes that Chen does not in fact teach the added limitations, this point was never questioned, as examiner utilized a rejection under 35 U.S.C. 103(a) against claim 2 with two references. Applicant showed why Chen does not teach the added limitations per se, but failed to in any way address the combination with the Schneider reference, as applied to the rejection of claim 2 under 35 U.S.C. 103(a). Therefore, a final rejection is proper and the original grounds of rejection (as modified to fit the new claim structure) are applied.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Applicant's assertion that Schneider does not teach template matching is incorrect. Schneider as stated below clearly teaches template matching (5:50-67, particularly 5:64-66). Since the segmentation could be done using template matching, obviously that constitutes a detecting unit that detects the position of said index (e.g. the fiducial marks) by segmentation **via template matching**, which Schneider teaches is well known in the art. The system of Schneider must **inherently** function in the manner of the system of applicant (see the example with Okumura below). A template-matching system always takes the image of a template (what applicant refers to as the template image of said index)(Figure 4 of Okumura) and compares it to the overall acquired image (e.g. the target image) to localize and obtain only the image of the desired region (the template area).

As an example, Okumura (US 5,878,156) teaches the use of template-matching techniques in 6:30-55, where in Figure 4 the use of template matching is shown, where a rectangular face-template 10 is selected from a target image as in Figure 5, and then the eye region template is used to extract the eyes from that image. Okumura is a good example of how template-matching techniques inherently work.

Also, it is noted for purposes of appeal that claim 26 is in all probability non-statutory. It is further noted that such a new grounds of rejection will be added to the Examiner's Answer, since the Board would otherwise remand such a case for the addition of such grounds. Applicant is advised that such a rejection may be avoided by filing an amendment under Rule 312 combining claims 26 and 27. If any other matter is

submitted with such an amendment prior to the filing of the appeal brief, such an amendment will not be entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1, 9, 17, 24, 26-27, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Schneider.

As to claim 1,

Chen et al. discloses the system and method as claimed in claims 1 and 24. Chen et al. describes a surgical targeting system that involves displaying an image created by intermixing a virtual image with a real image. Column 9, lines 38 – 43, describes aligning a real image taken from a video camera with a virtual image by holding the camera in a fixed position. "A first, and generally more preferable, technique involves holding the position of video camera 45 (and hence real image 55)

constant and moving the position of the "virtual object" or the "virtual camera" by means of apparatus 57 until the virtual image 50 is brought into registration with real image 55." Column 11, lines 7 – 11, states, "More particularly, and looking now at FIG. 8, there is shown a video camera 45, an anatomical structure 60, and a tracker system 65. Tracker system 65 comprises a tracker 70 which is attached to video camera 45, and a tracker base 75 which defines the coordinate system of the tracker system." Thus, Chen et al. teaches of an orientation sensor for measuring the orientation of the video camera (see 3:65-4:10). Lines 12 – 17 disclose matrix transformations from the patient to the camera, the camera to the tracker base, and the patient to the tracker base. Thus, calculation information is stored in the matrix transformations to calculate the orientation of the patient on the basis of an output from the tracker system. Column 6, lines 61 – 67, and column 7, lines 1 – 5, describe the use of an imaging machine to provide two-dimensional images of a patient's anatomical structure and storing the images in a patient-specific database. Column 8, lines 10 – 46, discloses the placement of virtual planning markers in the patient-specific images by a physician. Column 9, lines 43 – 47, describes a detecting algorithm to perform a template matching process between planning markers of a virtual image and a target image. "This can be done automatically by having image generator 30 use a search algorithm to match the virtual image to the real image, in which case apparatus 57 includes computer hardware and software of the sort well known in the art to cause image generator 30 to work through a search algorithm to match the virtual image to the real image." Column 12, lines 26 – 37, discloses detecting the position of an anatomical

structure in a real image by performing a data matching procedure to correlate sampled points with patient-specific images. "It is also anticipated that one could use a tracked surgical instrument 85 to determine the location of anatomical structure 60. This can be accomplished by using the tracked surgical instrument 85 to engage known fiducial points on the anatomical structure. Alternatively, a tracked surgical instrument 85 can be used to sample multiple surface points located on the anatomical structure and then use a data matching procedure to correlate the sampled points with either patient-specific database 10 or patient-specific 3-D computer model 15." Column 11, lines 18 – 29, describe an updating of the calculation information on the basis of a detected position of a marker in the patient image then calculating the orientation of the patient in relation to the tracker system on the basis of known values and the updated calculation information from the matrix transformations. "M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system."

The template matching operation is inherent to Schneider, as discussed above in the Response to Arguments section, the relevant portion of which is incorporated by reference.

Chen et al. discloses the device of claim 1 except wherein said target image setting unit obtains a predicted position of the index in the picked-up image employing said measured value and said calculation information stored in said storage unit and creates an image with a peripheral area around said prediction position in said picked-up image subjected to a rotational process on the basis of a rotational angle in a roll direction of said image pick-up device derived from said measured value. The invention of Schneider teaches of obtaining images in a pre-procedural time and segmenting them into sub-objects that have defined boundaries, shapes, and positions within the overall image. Column 8, lines 36 – 52, describes segmenting the images while they are digitally analyzed to identify predefined fiducial markers by means of feature extraction, edge detection, region growing, boundary analysis, template matching, etc. Column 9, lines 4 – 10, states, "Particularly likely to be useful in the future are those statistical segmentation techniques that assign to each point a certain degree of probability as to whether or not it is a part of a given segmented object. That probability is based upon a variety of factors including pixel intensity and location with respect to other pixels of given qualities. Once probabilities of each pixel have been determined, assessments can be made of the pixels as a group, and segmentation can be achieved with improved accuracy." Additionally, column 10, lines 4 – 15, teaches of rotating captured images so as to align the images, according to the fiducial markers, to a

corresponding position orientation. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include segmenting the captured virtual images so as to include a peripheral area around a predicted position of the index. One would have been motivated to make such a modification to the invention of Chen so that upon performing template matching between virtual and real images, the speed of identifying marker matches is increased by bounding a search area within a smaller particular region of the overall image. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to include subjecting the captured images to rotational process. One would have been motivated to make such a modification to the invention of Chen so that while performing template matching between a virtual and a real image, the orientations of the images may be aligned so as to properly line up their fiducial markers.

As to claim 9,

Chen et al. discloses the device of claim 9. Column 11, lines 12 – 29, discloses calculation information in the form of matrix transformations for calculating the position and attitude of the patient on the basis of the measured value and position information of the pick-up visual point of the camera in regard to the tracker system. "In this setting, M.sub.PC can be considered to represent the matrix transformation from the patient's anatomical structure 60 to camera 45; M.sub.CT can be considered to represent the matrix transformation from camera 45 to tracker base 75; and M.sub.PT can be

considered to represent the matrix transformation from anatomical structure 60 to tracker base 75.

M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system." Therefore, the calculation information is updated once the virtual image is placed in registration with the real image generated by the camera and the matrix transformations are formed.

As to claim 17,

Chen et al. discloses the device of claim 17. Column 10, lines 1 – 15, states, "Once virtual image 50 has been placed into proper registration with real image 55, image generator 30, video camera 45 and video mixing device 35 can be used to present the virtual and real images on display 40 in various presentation formats so as to facilitate a particular medical procedure. In particular, one can use image generator 30, video camera 45 and video mixing device 35 to superimpose a virtual image (generated from patient-specific 3-D computer model 15) against a real image (generated by video camera 45), with image generator 30 being directed to modify the virtual image so as to expose one or more of the virtual planning markers 25 present in

patient-specific 3-D computer model 15, whereby the anatomy highlighted by virtual planning markers 25 will be brought quickly to the attention of the physician." Thus, real image is a visual point of the visual camera. Additionally, column 9, lines 43 – 49, notes a search algorithm to match the virtual and real images. "This can be done automatically by having image generator 30 use a search algorithm to match the virtual image to the real image, in which case apparatus 57 includes computer hardware and software of the sort well known in the art to cause image generator 30 to work through a search algorithm to match the virtual image to the real image." The change in wording from 'display means' to 'display device' from the incorporated limitations from the former claim 18 as well as other cosmetic changes does not change claim scope.

As to claim 24,

Chen et al. discloses the method as claimed in claim 24. Chen et al. describes a surgical targeting system that involves displaying an image created by intermixing a virtual image with a real image. Column 9, lines 38 – 43, describes aligning a real image taken from a video camera with a virtual image by holding the camera in a fixed position. "A first, and generally more preferable, technique involves holding the position of video camera 45 (and hence real image 55) constant and moving the position of the "virtual object" or the "virtual camera" by means of apparatus 57 until the virtual image 50 is brought into registration with real image 55." Column 11, lines 7 – 11, states, "More particularly, and looking now at FIG. 8, there is shown a video camera 45, an anatomical structure 60, and a tracker system 65. Tracker system 65 comprises a tracker 70 which is attached to video camera 45, and a tracker base 75 which defines

the coordinate system of the tracker system." Thus, Chen et al. teaches of an attitude sensor for measuring the attitude of the video camera. Lines 12 – 17 disclose matrix transformations from the patient to the camera, the camera to the tracker base, and the patient to the tracker base. Thus, calculation information is stored in the matrix transformations to calculate the attitude of the patient on the basis of an output from the tracker system. Column 6, lines 61 – 67, and column 7, lines 1 – 5, describe the use of an imaging machine to provide two-dimensional images of a patient's anatomical structure and storing the images in a patient-specific database. Column 8, lines 10 – 46, discloses the placement of virtual planning markers in the patient-specific images by a physician. Column 9, lines 43 – 47, describes a detecting algorithm to perform a template matching process between planning markers of a virtual image and a target image. "This can be done automatically by having image generator 30 use a search algorithm to match the virtual image to the real image, in which case apparatus 57 includes computer hardware and software of the sort well known in the art to cause image generator 30 to work through a search algorithm to match the virtual image to the real image." Column 12, lines 26 – 37, discloses detecting the position of an anatomical structure in a real image by performing a data matching procedure to correlate sampled points with patient-specific images. "It is also anticipated that one could use a tracked surgical instrument 85 to determine the location of anatomical structure 60. This can be accomplished by using the tracked surgical instrument 85 to engage known fiducial points on the anatomical structure. Alternatively, a tracked surgical instrument 85 can be used to sample multiple surface points located on the anatomical structure and then

use a data matching procedure to correlate the sampled points with either patient-specific database 10 or patient-specific 3-D computer model 15." Column 11, lines 18 – 29, describe an updating of the calculation information on the basis of a detected position of a marker in the patient image then calculating the attitude of the patient in relation to the tracker system on the basis of known values and the updated calculation information from the matrix transformations. "M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system."

As discussed above, the template matching is inherent to Schneider.

The template matching operation is inherent to Schneider, as discussed above in the Response to Arguments section, the relevant portion of which is incorporated by reference.

Chen et al. discloses the device of claim 24 except template matching and certain other minor details. The invention of Schneider teaches of obtaining images in a pre-procedural time and segmenting them into sub-objects that have defined boundaries, shapes, and positions within the overall image. Column 8, lines 36 – 52,

describes segmenting the images while they are digitally analyzed to identify predefined fiducial markers by means of feature extraction, edge detection, region growing, boundary analysis, template matching, etc. Column 9, lines 4 – 10, states, "Particularly likely to be useful in the future are those statistical segmentation techniques that assign to each point a certain degree of probability as to whether or not it is a part of a given segmented object. That probability is based upon a variety of factors including pixel intensity and location with respect to other pixels of given qualities. Once probabilities of each pixel have been determined, assessments can be made of the pixels as a group, and segmentation can be achieved with improved accuracy." Additionally, column 10, lines 4 – 15, teaches of rotating captured images so as to align the images, according to the fiducial markers, to a corresponding position orientation. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include segmenting the captured virtual images so as to include a peripheral area around a predicted position of the index. One would have been motivated to make such a modification to the invention of Chen so that upon performing template matching between virtual and real images, the speed of identifying marker matches is increased by bounding a search area within a smaller particular region of the overall image. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to include subjecting the captured images to rotational process. One would have been motivated to make such a modification to the invention of Chen so that while performing

template matching between a virtual and a real image, the orientations of the images may be aligned so as to properly line up their fiducial markers.

As to claims 26 and 27,

Chen et al. discloses the program code of claim 26 and the storage medium of claim 27. Figure 10 shows an overall flow diagram of the invention of Chen. A program module is shown that runs an algorithm to align the real and virtual images. Thus, the algorithm to be run is interpreted as program code for executing the image processing method. Column 9, lines 38 – 49, describes the use of the algorithm including computer hardware and software such that the program code is stored on the hardware medium.

As to claim 28, this is merely a broadened version of claims 1 and 24, with the preamble encompassing some of the limitations (notably the first clause and the template matching portion of the detecting step), the orientation step, the target image-creating step of claim 1, and the detecting step.

Chen et al. discloses the device of claim 28, except wherein said target image setting unit obtains a predicted position of the index in the picked-up image employing said measured value and said calculation information stored in said storage unit and creates an image with a peripheral area around said prediction position in said picked-up image subjected to a rotational process on the basis of a rotational angle in a roll direction of said image pick-up device derived from said measured value. The invention of Schneider teaches of obtaining images in a pre-procedural time and segmenting them into sub-objects that have defined boundaries, shapes, and positions within the

overall image. Column 8, lines 36 – 52, describes segmenting the images while they are digitally analyzed to identify predefined fiducial markers by means of feature extraction, edge detection, region growing, boundary analysis, template matching, etc. Column 9, lines 4 – 10, states, "Particularly likely to be useful in the future are those statistical segmentation techniques that assign to each point a certain degree of probability as to whether or not it is a part of a given segmented object. That probability is based upon a variety of factors including pixel intensity and location with respect to other pixels of given qualities. Once probabilities of each pixel have been determined, assessments can be made of the pixels as a group, and segmentation can be achieved with improved accuracy." Additionally, column 10, lines 4 – 15, teaches of rotating captured images so as to align the images, according to the fiducial markers, to a corresponding position orientation. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include segmenting the captured virtual images so as to include a peripheral area around a predicted position of the index. One would have been motivated to make such a modification to the invention of Chen so that upon performing template matching between virtual and real images, the speed of identifying marker matches is increased by bounding a search area within a smaller particular region of the overall image. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to include subjecting the captured images to rotational process. One would have been motivated to make such a modification to the invention of Chen so that while performing template matching

between a virtual and a real image, the orientations of the images may be aligned so as to properly line up their fiducial markers.

Claims 3, 10-12, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Schneider as applied to claim 1 and further in view of Rallison et al.

As to claim 3,

Chen and Schneider disclose the device of claim 3 except wherein said calculation information is the correction information to correct for an error in the measured value of attitude measured by said attitude sensor of the image pick-up visual point of said image pick-up device, and said calculation unit calculates attitude of said measurement object on the basis of the measured value and correction information. The invention of Rallison et al. teaches of tracking the position and attitude of an image generator mounted on the head of a person. Column 19, lines 11 – 26, teaches of the various types of tracker systems including magnetic and inertial sensor systems. Columns 21, 22, and 23 explain obtaining position and attitude orientation with the two systems. Column 24, lines 37 – 67, and column 25, lines 23 – 62, describe correcting for an error in the measured values of attitude and position taken from the sensor systems. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include using an inertial sensor system as the tracker system for the video camera. One would have been motivated to make such a modification to Chen since inertial sensors such as rate gyros

will have the advantage of being substantially immune to magnetic perturbations that may be present in a medical operating atmosphere. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to correct for an error in the measured value of attitude information of the inertial sensors for use in the matrix transformation calculations of Chen. One would have been motivated to make such a modification to the invention of Chen so that the calculated position and attitude information of the camera and patient remain accurate while performing a medical procedure.

As to claims 10, 11, and 12,

Chen et al. discloses the device of claims 10, 11, and 12. Column 11, lines 12 – 29, discloses calculation information in the form of matrix transformations for calculating the position and attitude of the patient on the basis of the measured value and position information of the pick-up visual point of the camera in regard to the tracker system. "In this setting, M.sub.PC can be considered to represent the matrix transformation from the patient's anatomical structure 60 to camera 45; M.sub.CT can be considered to represent the matrix transformation from camera 45 to tracker base 75; and M.sub.PT can be considered to represent the matrix transformation from anatomical structure 60 to tracker base 75.

M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the

real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system." Therefore, the calculation information is updated once the virtual image is placed in registration with the real image generated by the camera and the matrix transformations are formed. Additionally, column 12, lines 35 – 37, describes using a least squares fit to correlate the sampled points with the patient-specific images. Thus, a typical value is used that incorporates a dislocation value between the predicted position and the detected position of a plurality of markers from a real and virtual image.

As to claim 20,

Chen et al. discloses the device of claim 20, see description according to claim 1, the rejection to which is incorporated by reference, except wherein a target image is created having a peripheral area around a predicted position in a picked-up image subjected to a rotational process on the basis of a rotational angle in a roll direction of said image pick-up device derived from said measured value. Chen et al. teaches in column 11, lines 3 – 11, of a tracker system attacked to a video camera such that the position of the camera will be predetermined by the tracker system. Schneider teaches of obtaining images in a pre-procedural time and segmenting them into sub-objects that have defined boundaries, shapes, and positions within the overall image. Column 8, lines 36 – 52, describes segmenting the images while they are digitally analyzed to identify predefined fiducial markers by means of feature extraction, edge detection,

region growing, boundary analysis, template matching, etc. Column 9, lines 4 – 10, states, "Particularly likely to be useful in the future are those statistical segmentation techniques that assign to each point a certain degree of probability as to whether or not it is a part of a given segmented object. That probability is based upon a variety of factors including pixel intensity and location with respect to other pixels of given qualities. Once probabilities of each pixel have been determined, assessments can be made of the pixels as a group, and segmentation can be achieved with improved accuracy." Additionally, column 10, lines 4 – 15, teaches of rotating captured images so as to align the images, according to the fiducial markers, to a corresponding position orientation. Thus, the position of the area to be segmented is determined by a statistical segmentation technique while the video camera is at a predetermined position. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include segmenting the captured virtual images so as to include a peripheral area around a predicted position of the index. One would have been motivated to make such a modification to the invention of Chen so that upon performing template matching between virtual and real images, the speed of identifying marker matches is increased by bounding a search area within a smaller particular region of the overall image. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to include subjecting the captured images to rotational process. One would have been motivated to make such a modification to the invention of Chen so that while performing template matching between a virtual and a real image, the orientations

of the images may be aligned so as to properly line up their fiducial markers. Motivation for combination with Schneider is taken from the rejection to claim 1, which has been incorporated by reference.

Claims 5, 7-8, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Schneider, and further in view of Rallison.

As to claim 5,

Chen et al. and Schneider discloses the invention of claim 5 except wherein said calculation information is the correction information to correct for an error in the measured value of attitude measured by said attitude sensor and the position information of the image pick-up visual point of said image pick-up device, and said calculation unit calculates the position and attitude of said measurement object on the basis of the measured value, correction information, and the position information. The invention of Rallison et al. teaches of tracking the position and attitude of an image generator mounted on the head of a person. Column 19, lines 11 – 26, teaches of the various types of tracker systems including magnetic and inertial sensor systems. Columns 21, 22, and 23 explain obtaining position orientation with the two systems. Column 24, lines 37 – 67, and column 25, lines 23 – 62, describe correcting for an error in the measured values of attitude and position taken from the sensor systems. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include using an inertial sensor system as the tracker system for the video camera. One would have been motivated to make such

a modification to Chen since inertial sensors such as rate gyros will have the advantage of being substantially immune to magnetic perturbations that may be present in a medical operating atmosphere. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to correct for an error in the measured value of attitude and position information of the inertial sensors for use in the matrix transformation calculations of Chen. One would have been motivated to make such a modification to the invention of Chen so that the calculated position and attitude information of the camera and patient remain accurate while performing a medical procedure.

As to claim 7,

Chen, Schneider, and Rallison teach of the device of claim 7. Chen and Schneider in view of Rallison teach of updating the position information with regard to a series of matrix transformations in column 11, lines 7 – 30. Additionally, column 9, lines 38 – 49, describe a search algorithm for automatically bringing a virtual image into registration with a real image. Column 10, lines 38 – 52, describes reestablishing the registration between a real image and a virtual image if the video camera position is moved. Thus, Chen, Schneider, and Rallison teach of updating position information. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen, Schneider, and Rallison so that the position information is only updated in two directions and not in a depth direction if the action is so desired by a user while reestablishing a registration between a real image and a virtual image. One would have been motivated to make such a modification to the

invention of Chen, Schneider, and Rallison so that if a user does not require an updated value in a depth direction, the computing system does not waste utilization time and resources calculating an unnecessary value.

As to claim 8,

Chen, Schneider, and Rallison explicitly disclose the device of claim 8 except wherein the correction information is the information to correct for an error in the azimuth direction among the measured values of the attitude measured by the attitude sensor. In column 23, lines 60 – 67, and column 24, lines 1 – 23, Rallison additionally teaches of sensor drift, thus causing an error in the measured values of roll, pitch, and yaw.

The definition of the term 'yaw' is "to turn about the vertical axis. Used of an aircraft, spacecraft, projectile, etc." The definition of the term "azimuth" is "the horizontal angular distance from a reference direction, to the point where a vertical circle through a celestial body intersects the horizon, usually measured clockwise. Sometimes the southern point is used as the reference direction, and the measurement is made clockwise through 360 degrees."

Therefore, the amount of yaw is the amount of turn around a vertical axis, while the azimuth is the amount of turn around a reference direction. The two terms are synonymous in this context, e.g. the amount of yaw deviation, drift, or error, is equivalent to amount of azimuth deviation, drift, or error.

Thus, it is inherent that the use of a gyroscopic tracking system in the invention of Chen and Schneider in view of Rallison will accumulate an error in the measured

directions, including the azimuth measurements. Therefore, the use of the yaw correction information in the matrix transformations in the invention of Chen and Schneider in view of Rallison is equivalent to the use of the azimuth correction information.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric V. Woods whose telephone number is 571-272-7775. The examiner can normally be reached on M-F 7:30-4:30 alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Razavi can be reached on 571-272-7664. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Eric Woods

Jeffery A. Brier
JEFFERY BRIER
PRIMARY EXAMINER

12 September 2005